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Forest Pest Management
Pacific Northwest Region

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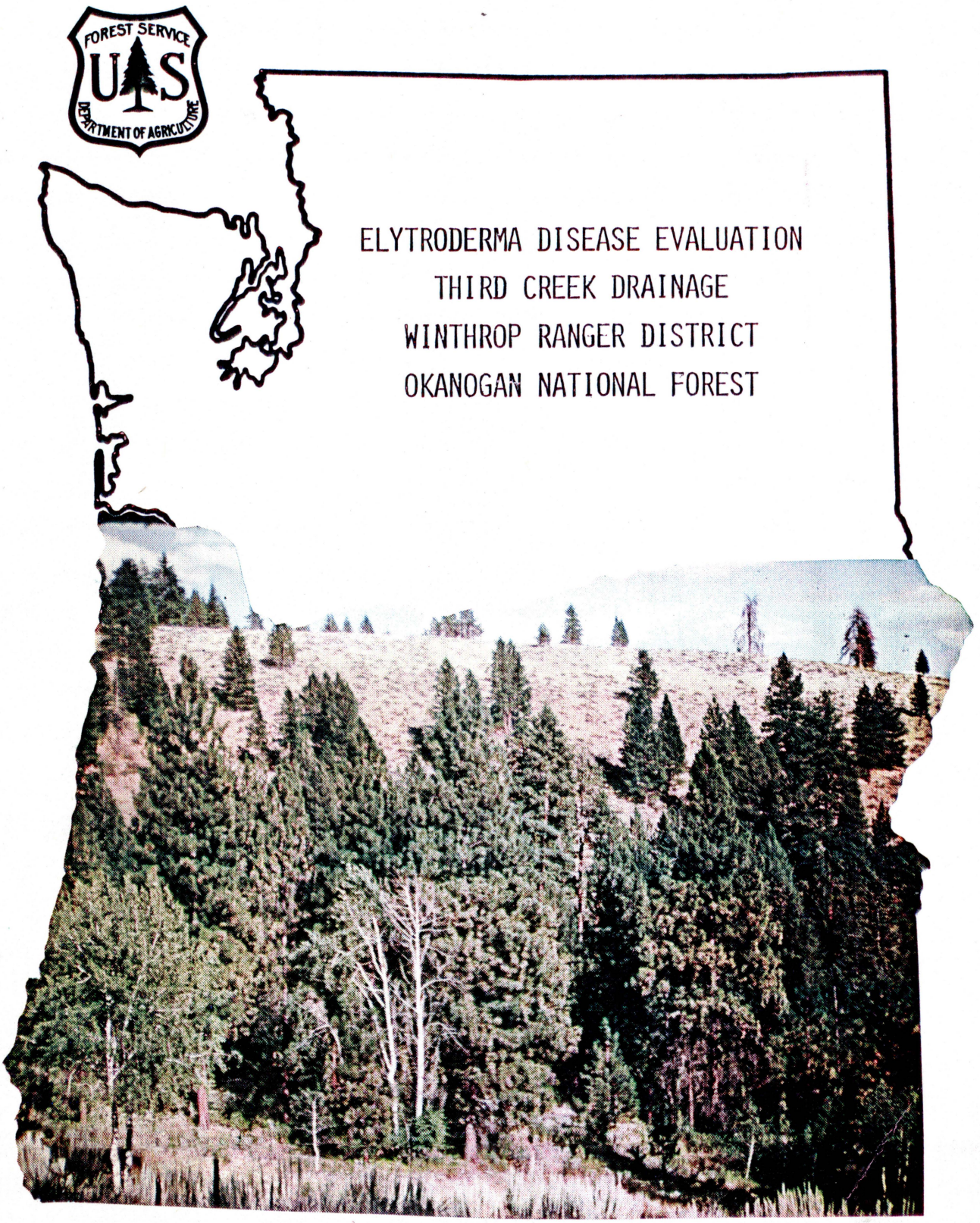

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THIRD CREEK DRAINAGE
WINTHROP RANGER DISTRICT
OKANOGAN NATIONAL FOREST

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by

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INTRODUCTION

During the week of August 16, 1982, Forest Pest Management personnel did a disease evaluation of stands within the Third Creek Drainage (T. 36 N., R. 21 E., sec. 19, 20, 29, 30, and 32) on the Winthrop Ranger District, Okanogan National Forest (Figure 1). The purpose of this evaluation was to determine the extent and severity of Elytroderma disease and to develop and recommend management alternatives for this and other forest pests in the area.

Stands in the Third Creek area are a mixture of all-aged ponderosa pine (*Pinus ponderosa*) and Douglas-fir (*Pseudotsuga menziesii*). Stocking varies with topography, being generally heavy in the bottom of drainages and sparse on ridge faces. Past management activities in these stands have included precommercial thinning and salvage or single tree selection cutting. The areas are also included in grazing allotments.

District personnel identified one block of approximately 520 acres in pine type to be of particular interest, and this was surveyed intensively.

METHODS

The survey block boundaries were identified partially from maps furnished by the District and also in the field by limits of pine stocking. A systematic survey was done by placing plots every 5 chains along transects located at 10-chain (660') intervals across the survey unit.

These plots were variable radius (BAF 20), defined by a Spiegel-Relaskop. The following data were collected on all ponderosa pine in each plot: (1) diameter breast height, (2) condition dead or alive, (3) crown class, (4) percent twigs

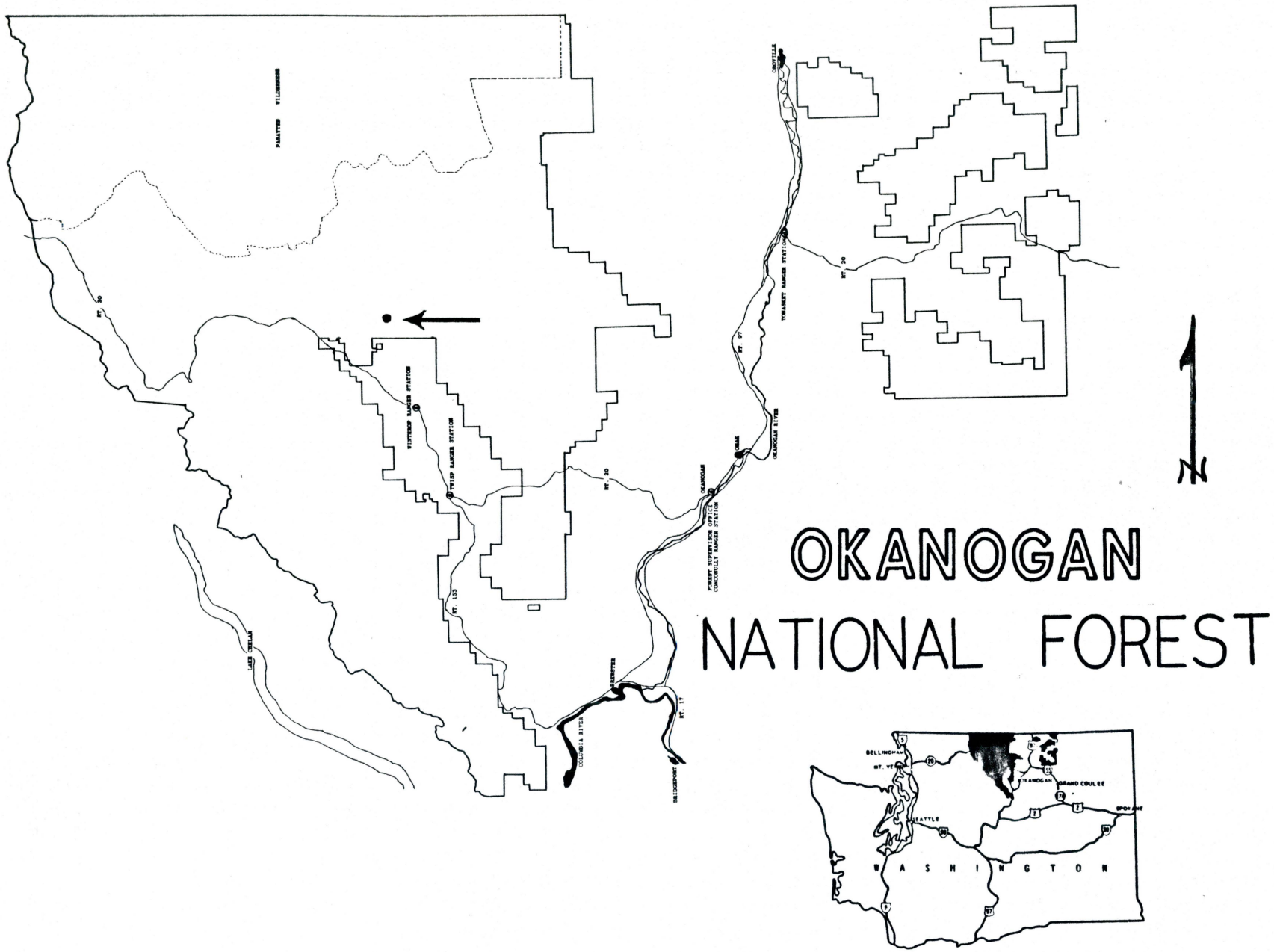

Figure 1. Map depicting location of the survey area (arrow).

infected by Elytroderma disease (visual estimate), based on the following rating: 0 - noninfected; 1 - 1-25% infection; 2 - 26-50% infection and 3 - 51%+ infection and (5) the highest order of infection occurring in each third of the crown (in increasing order)--noninfected-young flags; older, upward-turning flags; and brooms. Other tree species were tallied by species and DBH. Any other pest agents encountered were noted.

Data were tabulated to determine basal areas per acre and trees per acre. Elytroderma plot ratings were calculated by summing individual tree ratings and dividing by the number of ponderosa pines in the plot.

RESULTS AND DISCUSSION

Elytroderma disease was extensive and severe in the area surveyed (Figure 2). Of 92 plots taken, 20 had no pine, 13 were stocked with pine and were noninfected; 19 were infected with an average rating of 0.1-1.0; 25 had an average rating of 1.1-2; and 15 had a rating 2.1 or higher. Distribution of plots with average disease levels are indicated in Figure 2. Highest infection levels were found in and near bottoms of drainages, while healthiest trees were near ridges. The Elytroderma rating, based on percent twigs infected (Table 1), averaged 1.40 for all trees. There appears to be no significant rating difference between diameter classes. Of the total 210 pine plot trees, 59% (123) had 25% or less (low) twig infection; 26% (54) had 26-50% (medium) twig infection, and 10% (22) had greater than 50% (high) twig infection. Eleven (5%) of the pine were dead, all directly or indirectly caused by Elytroderma disease.

Basal area in the survey block averaged 69.8 $ft.^2$ per acre. This included 45.8 $ft.^2$ of ponderosa pine and 24.0 $ft.^2$ of Douglas-fir. Number of trees per acre averaged 37.1 for Douglas-fir and 64.3 for ponderosa pine (Table 1).

Childs (1968) presented radial increment growth loss data based on the following levels of infection: 0-30% (low) twig infection was considered base with no loss of growth, trees with 30-60% (medium) twig infection grew at 82.5% of this level, and trees with greater than 60% (high) infection grew at only 25% of the base of the healthy/low infection standard. While the percent twig infection classification levels are slightly different between Childs (1968) and this report, we will use Child's data to estimate the current loss of radial growth in the area surveyed. Our estimate is a total 12.2% reduction in growth. In addition, 5.2% of the pine basal area is dead and the mortality rate will increase as trees age unless the Elytroderma disease is managed.

Of all plot trees, 11% were healthy, 18% had recent flagging, 30% had older advance flagging, 37% had brooms, and 5% were dead (Table 1). The average DBH of trees with recent flags, advanced flags, and brooms were 14.9, 12.5 and 19.7 inches, respectively. Healthy trees averaged 15.8 inches and dead trees, 12.0. Brooming seemed to be more common on larger trees that were probably thrifty at the time of infection.

Dwarf mistletoe was found on some of the older Douglas-fir in the survey area. Infection extent and frequency was low. A few heavily-infected trees were found. These trees were scattered along Third Creek in the southern half of the survey block.

THIRD CREEK ELYTRODERMA DISEASE EVALUATION

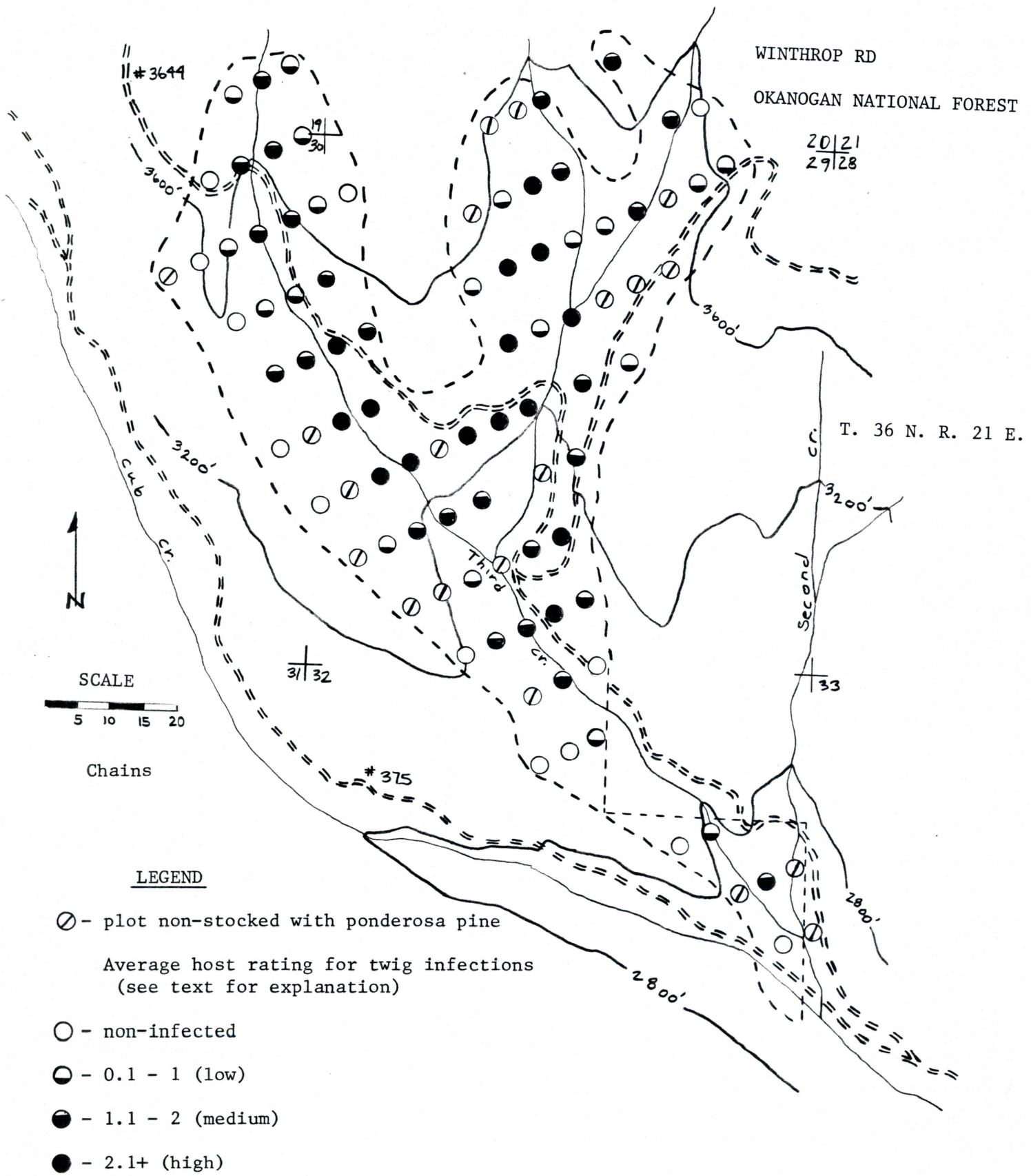

Figure 2. Location of cruise plots in the survey block

Western pine beetle activity was contributing to minor mortality in portions of the survey area where stocking and Elytroderma disease levels were high. All plot trees examined that were dead had been attacked by this insect. Remnants of brooms on these trees indicated Elytroderma infection also.

PEST BIOLOGY AND IMPACT

Elytroderma Disease

Elytroderma disease, caused by the fungus *Elytroderma deformans*, is a needle and twig disease of pine. Several species of pine are affected in the West; however, ponderosa pine is the only significant host in the Pacific Northwest Region. Damage to trees includes premature death of 1-year-old needles, brooming, deformation and killing of twigs and branches, and tree killing. Minor impact occurs to growth rates until about 40% of the twigs are infected, after which loss can become quite substantial (Smith 1979). Mortality may occur due to heavy infection, either outright, or in conjunction with other pests, especially bark beetles.

Elytroderma deformans normally occurs at low, endemic levels in pine stands. Occasionally in some sites when environmental conditions are optimal, namely high fall humidity and cool temperatures, spores are produced and disseminated and infection can reach epidemic proportions. Spore release and infection of current season's foliage occurs in late summer and fall. Simultaneous appearance of heavy initial infections regionwide in certain years indicates large-scale optimum weather conditions that favor outbreaks (Childs 1968). Once an outbreak occurs, trees remain infected because the fungus often becomes systemic. Further significant tree to tree spread may not reoccur until favorable environmental conditions again develop.

Symptoms of Elytroderma are most striking in the spring just prior to emergence of new foliage. Bright red-brown flags on twig ends appear as the previous season's needles die. This alarming appearance is softened somewhat when the new green foliage emerges.

As mentioned earlier, the fungus can become systemic, spreading from infected needles into buds and twigs and causing necrotic lesions in the latter. These can be found in tangential sections of infected twigs (Plate 2). Infected twigs will flag again the following spring and start to curve upward. Twigs often die after having been infected for several years. However, on thrifty trees with vigorous, although infected branches, "witches'-brooms" will eventually develop and usually persist for decades (Plates 3 and 4).

Trees that are heavily infected will have flags and brooms throughout their crowns (Plate 4). High levels of twig mortality and/or brooming will eventually result in low vigor and growth. Susceptibility to attack and subsequent mortality induced by other pests, such as bark beetles, may be increased by heavy *E. deformans* infections.

Dwarf Mistletoe

Douglas-fir dwarf mistletoe (*Arceuthobium douglasii*) is a parasitic plant that is a serious pest of Douglas-fir in many areas east of the Cascade Range. Like most species of dwarf mistletoe, it is host-specific, affecting only Douglas-fir.

Plate 1. Fruiting bodies of *Elytroderma deformans* on ponderosa pine needles (black elongated spots).

Plate 2. Tranverse section of ponderosa pine twig showing necrotic lesions caused by *Elytroderma deformans*.

Plate 3. Small "witches'-broom" on ponderosa pine caused by *Elytroderma deformans*.

Plate 4. Ponderosa pine heavily infected with Elytroderma Disease. Both flags and brooms are present.

Dwarf mistletoes harm their tree hosts by drawing on their photosynthate and water reserves, thus lowering their vigor and growth. Abnormal branch formations are produced by the tree in response to dwarf mistletoe infection. These include "witches'-brooms" and abnormally large branches. A tree's grade and value are reduced because of these abnormalities. Dwarf mistletoe populations increase gradually within infected trees. Vigor is reduced to such a degree that trees die outright or are attacked and killed by other pests.

Western Pine Beetle

The western pine beetle (*Dendroctonus brevicomis*) most commonly attacks overmature ponderosa pine. It is particularly common on trees of reduced vigor. Mortality attributed to this bark beetle is often partially due to the weakening effects of other pests such as Elytroderma.

MANAGEMENT ALTERNATIVES AND RECOMMENDATIONS

Elytroderma disease is prevalent in most of the survey block and is sufficiently damaging to warrant management action. This disease will probably always be present in this area, but the frequency and extent of outbreaks cannot be predicted since they are so weather dependent.

Management strategies are available for minimizing disease intensity and resulting losses, while considering stand and site characteristics and other resources. The following alternatives should be considered:

(1) Species manipulation - Douglas-fir could be favored in the moister sites where it is already a stand component. These moist sites have the highest levels of Elytroderma disease. However, if Douglas-fir is favored, dwarf mistletoe will be a management concern. A series of small group selection units or larger, heavy shelterwood harvests can be used to remove heavily-diseased ponderosa pine and dwarf mistletoe-infected Douglas-fir. Retaining healthy Douglas-fir as seed trees or planting Douglas-fir seedlings in larger openings will result in a higher proportion of Douglas-fir stocking.

(2) Sanitation/salvage - Using this silvicultural system, the dead, dying, and heavily-diseased pines can be removed. The intensity of cutting should be dictated by the level of disease in different areas. Only healthy, or lightly infected (1-25 percent twig infection) trees should be retained where Elytroderma is heavy. In healthier areas, good spacing should be maintained to aid in vigor and maximize live crown ratios. Where disease levels require a heavy removal, regeneration, either natural or artificial, will be needed to retain full stocking.

(3) Regeneration harvests - In the less harsh sites off the ridges where Elytroderma is most prevalent, complete stand replacement should be considered. This could be accomplished in one step as clearcuts, or in several steps using shelterwood or seed tree methods. These systems can eliminate dwarf mistletoe within these units, while establishing vigorous young stands. Dwarf mistletoe-infected shelterwood or seed trees should be removed before susceptible regeneration is 3 feet tall or 10 years old, whichever occurs first.

Infection of healthy pine by Elytroderma will probably occur in future disease outbreaks; however, losses can be mitigated. Maintaining good spacing in stands with trees of high vigor and full crowns will minimize future losses to Elytroderma disease.

Recommended actions are as follows:

(1) Prioritize areas for treatment. These should be based on disease levels (Figure 2) and other resource considerations.

(2) Analyze various alternatives and combinations to meet management objectives.

(3) Train marking crews to identify proper leave and take trees, based on level of management, when entries are planned. The least desirable leave trees are those with:

a. flagging in the upper 1/3 of the crown (in young trees);

b. brooming in the upper 2/3 of the crown;

c. over 1/2 of their twigs flagged;

d. low crown ratios ($< 40\%$).

LITERATURE CITED

Childs, T. W.
1968. Elytroderma Disease of Ponderosa Pine in the Pacific Northwest. USDA Forest Service, Pacific Northwest Forest and Range Experiment Station, Research Paper PNW-69.

Smith, R. S., Jr.
1979. *In* Diseases of Pacific Coast conifers. R. V. Bega. Technical Coordinator, USDA Forest Service, Pacific Southwest Range and Experiment Station. Agriculture Handbook No. 521.

Table 1. Stocking Level and Frequency of Elytroderma Disease by DBH Class over 520 Acres, Winthrop RD

DBH Class	Basal Area/Acre: Douglas-fir	Basal Area/Acre: Ponderosa pine	Trees/Acre: Douglas-fir	Trees/Acre: Ponderosa pine	Elytroderma rating[a] (see text)	Highest Level of Infection (Percent Stems) — Ponderosa pine: Healthy	Flags	Advanced Flags	Brooms	Dead	(n)
4	0.7	0.9	7.5	10.0	1.25	25	50	25			4
6	0.2	2.0	1.1	10.0	1.38	33	11	22	11	22	9
8	1.3	3.3	3.7	9.3	1.80	7	27	60	7		15
10	3.9	5.2	7.2	9.6	1.54	8	21	54	4	13	24
12	9.0	10.2	11.5	13.0	1.36	9	17	34	30	11	47
14	3.7	4.3	3.5	4.1	1.11	10	25	35	30		20
16	1.5	3.0	1.1	2.2	1.64	7		36	57		14
18	1.8	4.6	1.0	2.6	1.19	5	24	24	48		21
20	0.4	3.7	0.2	1.7	1.35	12	12	6	71		17
22	0.4	0.7	0.2	0.2	2.0	33			66		3
24	0.4	1.3	0.1	0.4	1.5	17			83		6
26	0.0	0.4	0.0	0.1	1.5	50			50		2
28	0.2	1.3	0.1	0.3	1.67	17		17	67		6
30	0.4	2.0	0.1	0.4	1.44	11	11		67	11	9
32	-	1.3		0.2	1.33		67		33		6
34	-	0.4		0.1	0.0	50			50		2
36	-	0.4		0.1	2.0			50	50		2
38	-	0.4		0.1	2.0				100		2
40	-	0.0		0.0	0.0						
42	-	0.0		0.0	-						
44	-	0.0		0.0	-						
46	-	0.2		<0.1	2.0				100		1
Totals	24.0	45.8	37.1	64.3							
Grand Totals	69.8		101.4								
Average					1.40	11	18	30	37	5	

[a] - Percent twig infection rating: 0 = noninfected; 1 = 1-25% twigs infected; 2 = 26-50% twigs infected; 3 = 51+% twigs infected

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